PRINCIPLES OF RAPID ACQUISITION AND SYSTEMS ENGINEERING

GRADUATE RESEARCH PROJECT

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Abstract

The purpose of the research was to explore and develop a set of principles common to rapid acquisition and expedited engineering programs utilizing grounded theory and qualitative research methodologies. To accomplish this goal, the Systems Engineering Research Council (SERC) research team interviewed over 30 organizations from across the DoD which focus on less traditional acquisition approaches such as rapid prototyping, mature technology integration, or extensive platform engineering. A set of standardized questions grouped by taxonomy of people, product, and process was used to guide open discussions. The responses from the interview notes were analyzed for trends. A set of 12 principles were identified from repeatedly emerging concepts in the systems engineering or acquisition processes of these organizations. While rapid acquisition offices often have unique attributes and permissions, these principles may be applicable to traditional acquisition programs.

Dedication

To our brothers and sisters in the acquisition and engineering community, there is much we have learned from this process - we hope what is contained in these pages is useful to you.

"We can't solve problems by using the same kind of thinking we used when we created them"
-Albert Einstein

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Thank you!

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Introduction

General Issue

The lifecycle of Joint Urgent Operational Needs (JUON) programs is typically driven by "time to market" constraints, as opposed to complete satisfaction of a static set of program or technical requirements. As such, product or capability delivery is expected in days or months rather than the typical years or decades for a traditional acquisition program. A recent Defense Science Board (DSB) Task Force identified more than 20 rapid-reaction programs and organizations existing to address DoD urgent warfighter needs (Defense Science Board, 2009). In addition, this study found that urgent-needs programs spent more than $50 billion between 2005-2009, and urgent needs should be considered a critical, ongoing DoD institutional capability. A subsequent report effectively details the status of rapid programs today:

> "Over the past decade, each military service and the Office of the Secretary of Defense established rapid acquisition activities to accommodate these [urgent needs] situations. In fact, more than 20 such organizations exist in the Department today. While many urgent needs were met through the efforts of these activities, problematic elements have emerged. Many are overstaffed, yet in some cases without sufficient domain, technical or acquisition experience. There are logistics and sustainment challenges with these capabilities once delivered to the warfighter. They also require rapidly available funds, which until now have come largely from supplemental funding to the defense budget. Further, there are no comprehensive plans to institutionalize and/or sunset these many rapid acquisition activities. The key elements to rapidly respond to unexpected operational needs include: be 'schedule-driven'; have available authority and funding; be staffed with a small group of experienced people; and have full, senior-level support for obtaining necessary waivers. Each Service should transition to a single rapid acquisition organization established similarly to the Air Force "Big Safari" program, with a small, very capable, and experienced staff of 20 – 50 people" (Defense Science Board, 2011)

Research Focus

The Systems Engineering Research Center (SERC) has been charged with investigating expedited systems engineering and rapid acquisition processes, and thus created a project to explore these concepts, named "Research Task (RT) – 34". The RT-34 research examines how

current “rapid” organizations apply acquisitions and engineering methodologies to satisfy urgent military needs developed in response to changing threats. RT-34 research is focused on leveraging currently available methods, processes, and tools to create an expedited systems engineering framework which is to be validated in practice. Additional RT-34 efforts include a specific entrepreneurial focused review, organizational psychology research, software modeling, and product family definitions

This particular research effort results as a subset of the RT-34 effort, called RT-34α. The RT-34α researchers focused on data collection and initial analysis of the organizational interviews. This analysis is to document the state of the current rapid acquisition environment and give the overall RT-34 team a solid foundation for development of an applicable framework and design of experiment for future application in the field. To make the RT-34α effort useful as a standalone product, the researchers endeavored to create a “guidebook” capturing the fundamental principles of rapid acquisition as they were observed through the research process. The results will be combined with additional products and analysis from RT-34 for the application phase of the overall research task.

Research Question and Hypothesis

The research question of this study was: Is there a common set of practices that drive the business model of rapid organizations? The hypothesis of RT-34α is that rapid acquisition processes are governed by a common set of principles. Via interview sessions with these organizations, the expected outcome is an emergence of these common governance principles. Potential second order effects are that expedited SE and rapid acquisition concepts could improve processes for traditional programs.

Methodology and Investigative Questions

The research team set out to discover consistent or unique attributes of rapid organizations. How do these organizations field military capabilities in half the time of their traditional counterparts? What makes them tick? Is there a "secret sauce"? Are they just breaking all the rules? Through the interview processes, a list of questions (see Appendix C) guided open discussions, and did not specifically force closed responses to each question. The questions generally addressed *people, process*, or *product* characteristics of the rapid acquisition efforts. The researchers held one to two hour conversations with each organization (ranging from a single representative to a small group of senior leaders) and did not focus on specific programs.

The method in this research is based on grounded theory. Grounded theory is a type of qualitative research methodology that allows theories to emerge from the collected data. This collection of data comes from notes during interviews with the leadership of these “rapid” organizations—essentially experts in the field—to discern what made them successful and discover what drove their processes. The research follows a systematic, yet flexible process to collect data, code and analyze the data, make connections, and see what theories can be generated. This "open coding" of labels is an important part of the analysis concerned with identifying, naming or labeling, categorizing, and describing phenomena found in the interview notes. In this case, the theory is a set of principles for successful rapid acquisition.

Limitations and Assumptions

The qualitative nature of this data and grounded theory research allows for interpretation depending on the readers or researchers point of view. Qualitative analysis can therefore become biased based on individual experience and perspective. The research team endeavored to stay

aware of bias in guiding discussions and interpreting data. Further, these interviews were conducted as guided conversations as opposed to strict survey responses. The research team ensured the topic of each question was covered within the course of each conversation and felt better data was acquired by allowing the interviewee to discuss the organization and its processes in their own way.

While the RT-34 team interviewed over 30 organizations, this report analyzed data from a sub-set of the interviews—covering 22 different interviews and briefings. Target of opportunity and short notice interviews afforded great openings for data gathering, but not all team members were able to attend all interviews. The data sets used for this research (RT-34α) are limited to those personally conducted by the authors or those with which they have considerable background information to provide interview context. It is expected the full dataset will eventually be examined. These 22 organizations are listed in Table 1. The names of specific commercial companies have been removed.

Many of the organizations interviewed were managing classified programs with classified customers. All interviews were conducted in an unclassified environment. This may have limited the extrema of detail provided and potentially prevented full disclosure of organizational practices. Further, this precluded detailed discussions on specific products these organizations have delivered or are developing at the time of this writing.

It is an underlying assumption that the organizations interviewed achieved success in some right, whether that be cost, schedule, or delivering a product to the field. Attempts were not made to explicitly define success in these organizations, but rather assume that by their very nature and existence, they are successful in some way.

Table 1. List of Organizations Interviewed

	Organization	Date
1	American Institute of Aeronautics and Astronautics Space Panel	28 Sep 11
2	Technology design, R&D, consulting firm	28 Sep 11
3	An aerospace industry futures lab	28 Sep 11
4	A rocket engine design company	30 Sep 11
5	Annual SERC Research Review (multiple presentations and interviews)	5 Oct 11
6	European satellite development company	10 Oct 11
7	NASA Goddard Space Flight Center	12 Oct 11
8	Joint Operationally Responsive Space Office	17 Oct 11
9	USAF Space Development and Test Directorate	18 Oct 11
10	Air Force Rapid Capabilities Office (RCO)	7 Nov 11
11	National Reconnaissance Office (NRO)	16 Nov 11
12	Academic institution	12 Dec 11
13	U.S. Army Product Integration Facility (PIF)	13 Dec 11
14	Engineering, applied science, and information technology company	13 Dec 11
15	Big Safari (USAF Program Executive Office, ISR-SOF)	13 Feb 12
16	Air Force Research Lab(AFRL) Center for Rapid Product Development	13 Feb 12
17	Aeronautical Systems Center, Rapid Development Integration Facility (RDIF)	13 Feb 12
18	AFRL Air Vehicles Directorate	13 Feb 12
19	Air Force Space Command / A5	12 Mar 12
20	Space and Missile Systems Center, Rapid Reaction Branch	13 Mar 12
21	Air Force Tactical Exploitation of National Capabilities (TENCAP)	13 Mar 12
22	Space and Missile Systems Center HQ	14 Mar 12

Finally, it is also important to note the data collected in these interviews is the foundation for the principles presented. However, based on requests from most of these organizations—and at times the condition of the conversation with them—we do not relate statements or anecdotes with specific personnel or organizations this presentation of the data.

Implications

This guidebook is the first result of the RT-34 research. It is intended for a general acquisition and engineering audience as an avenue of discussing the "business model" of rapid organizations. The successful techniques seen in rapid organizations are potentially applicable and scalable to more complex and long-standing weapon system development programs.

The Guidebook

This guidebook provides insights into the consistently recurring characteristics of rapid organizations. Through analysis of the data emerged 12 "principles" of rapid acquisition and expedited systems engineering (SE). These principles could also be called "habits", "tenants", or "heuristics". Whatever the name, RT-34α research shows these 12 principles as the driving and defining behaviors of these organizations. These principles are organized into three categories; people, process, and product. Each grouping of principles is centered on these categories, defined as follows:

People – (the who) – The characteristics, knowledge, education, and behaviors of the personnel in these organizations.

Process – (the how and where) – Describes key programmatic and system engineering strategies used to successfully execute rapid product development.

Product – (the what and why) – Defines conceptual use of technology used to meet the operational needs of warfighters.

The principles of rapid acquisition and expedited SE are listed and discussed in a numbered sequence; however no single principle is necessarily more important than another.

PEOPLE

Principle 1: Build and Maintain Trust
Principle 2: Populate Your Team with Specific Skills and Experience
Principle 3: Maintain High Levels of Motivation and Expectations
Principle 4: The Government Team Leads the Way

Principle 1: Build and Maintain Trust

- Develop solid relationships and work to maintain them
- Empowered leadership
- Autonomy for Program Managers/Engineers
- Consistent customer input & buy-in every step of the way

Building and maintaining trust enables empowered teams working together, being allowed to make decisions, leaders standing behind their decisions, and dealing with success or failures as they are encountered. This building process is a struggle at times and may even involve internal and external conflicts. These conflicts must be enriching experiences, opportunities to learn, grow, cooperate, and move forward.

Interviews repeatedly showed leadership at all levels providing top cover to allow teams to focus on executing the mission. These same leaders must be empowered and trusted at the lowest level possible to make tactical and strategic decisions. When decision making authority is placed at a low level it shortens the process, reduces opportunity for stall time, and fosters close relationships.

Most interviews conducted circled back to strong relationships with the customer. From this perspective, it was vital to have the customer consistently involved in the decision making process and to gather their feedback as the process moved forward. This was accomplished in many different ways: Short- and/or long-term on site customer representatives, customer input and regular conversations through reviews, or simply a close relationship and coordination process. Regardless of how the customer was included on the team, it was clear that trust in the team's ability to deliver was vital to project success.

Trust is built through expertise, show of confidence, and record of performance. On the outside, it appears relationships exist on an organizational level. However, interviews showed building and maintaining trust within a program team required constant nurturing. Further, trusting relationships showed just as important between individuals within these teams as building and maintaining trust with customers and senior leaders. It was consistently demonstrated that personal trust relationships at every level built foundations for organization reputation and credibility. In addition, the existence of a trust network appeared important for developing connections inside and outside the organizations. Further, personal trust networks became intertwined – enhancing and extending the capabilities and connections between organizations. This helps quickly build trust by leveraging pre-existing and proven relationships to build new ones.

Individuals build trust with one another through demonstrated commitment and competence. A successful acquisition team must have highly skilled acquisition professionals. But it is only through the consistent application of those skills that trust is built with leadership and individual or organizational autonomy is granted. Thus, not only must the desire to grant autonomy or empowerment exist in the leader, it must be earned by those at the lower level. It is on the back of established trust relationships with senior leadership and the customer that this autonomy allows small teams to rapidly move programs forward.

Principle 2: Populate Your Team with Specific Skills and Experience

- Hand pick your team…or grow your own
- Acquire people with the right education, experience, and personality
- Build the right team for each project

Interview data alluded to hand picking teams and developing specific skill sets as a key aspect of success. Data indicated over 90% of the interviewed organizations handpicked their staff. Organizations identified required skills needed for each project and took necessary actions

to acquire that skill set. Several methods of acquiring these skill sets were used: handpick new individuals, grow/groom current personnel, hire contractor support, and reorganize teams. For these organizations, these vital individuals, either of their own accord or external grooming, become experts with very specific skill sets and experiences. These individuals can then apply their skill sets to projects with specific customers, technologies or operational contexts.

Several senior leaders interviewed brought focus to expertise by indicating that a vital trait of aggressive DoD acquisition involves acute proficiency and depth concerning the application of the so-called "normal" acquisition process. In order to tailor the applicable rules of acquisition and engineering, team members must first understand what the rules are and which rules or processes apply to the situation. People with deep roots and experience in acquisitions, contracting, finance and engineering know what the standard processes are. They have executed large and small projects using various methods and standards. Thus, they are keenly aware of the implications from omitting a step or the challenges in executing parallel development processes. Their expert knowledge of the proper process allows them to create a process specifically designed to meet the needs of their program.

One particular organization interviewed was not 100% selectively manned. As leadership determines not only the technical strengths of the team, but the activities that bring staff personal reward, organizations can re-evaluate their internal structure. When asked how they organized the team to account for this, they stated, "We evaluate our team by the strengths and skill sets we are given. If we have to reorganize a flight to meet the skill set of the team we have, we do it. Finding out what a team member enjoys and is good at and letting them work in that area all but makes up for lack of 'handpicking' every member." In some cases, a person with the right attitude, personality, or motivation can make up for a lack of technical skill or

experience. In other words, this organization was able to make up for a specific lack of knowledge and skill, by strategically leveraging the strengths of the personnel they had—even if that meant moving personnel around as projects progressed through the organization.

Besides the desire to hand select personnel, most of these organizations required a long term commitment, particularly for military personnel. Instead of the typical two year job rotation, military members are on three to four-year controlled tours—only released for command, Professional Military Education opportunities, or other unique situations. Organizations cited a desire to keep good talent as long as possible, and influence on-the-job experience as individuals grew in their ability to execute organizational processes.

Principle 3: Maintain High Levels of Motivation and Expectations

- Motivation and mindset: Collaborative, competitive, impatient, creative, technical, tangible results, independent
- Mistakes are OK, but it is not OK to repeat them
- Every member connected to the mission and vision

As the research team interviewed these organizations, a certain enthusiasm was noticed abounding in the leaders and personnel—seeming to share a state of mind that was somehow traditionally military *and* entrepreneurial in spirit. The mindset of these individuals expressed a competitive nature born from a unique skill set, an aggressive and competitive environment, and a tangible connection to helping accomplish an operational mission. They are motivated.

Through discussion, this motivation appears to emanate from three primary sources. First, there is a direct connection to an operational community. Working closely with the end users creates both a connection to the operational task at hand and puts a face on the customer. The team is not just rushing to develop an oxygen sensor for F-22 pilots; they are developing it for Capt Josh “Tread” Saufley, so he avoids getting hypoxic on his next flight. Second, there is a sense of urgency. JUONs by their nature are “urgent” and of critical importance. Providing

capability to the field may very well be a matter of survival and mission success for US military members. Finally, the rapid nature of these projects provides a tangible result not typically experienced by members of the acquisition and engineering community. Members of the rapid acquisition community have the opportunity to see a project from concept definition, through development, and launch it into operational use. This concrete effect of seeing the fruits of labor utilized by its intended customer can be very powerful and help maintain sustained levels of motivation--even through long and arduous workdays.

A unique environmental characteristic observed in several organizations was one in which mistakes are OK, but not OK to be repeated. This concept is vital to fostering a creative, collaborative, and yet competitive environment. One specific technique observed to hone organizational skills is a "debrief culture". Originating from the operational world of reviewing a mission, focused debriefs on team performance can be extremely powerful. A debrief culture emphasizes learning from mistakes and works to identify root causes (individual or organizational) to improve future endeavors. Furthermore, the debrief process may be applied to iterations or phases of current projects in addition to a final project debrief. The purpose of a focused debrief is to determine what went wrong and develop "lessons learned" (much like a detailed heuristic) to prevent the same errors from occurring in the next project or subsequent iterations of the current project.

The debrief culture must be established at the top level of the organization where leaders outline and enforce the expectations and importance of the debrief process. A successful debrief methodology centers on developing focus points derived from the comparison of the project's intended objectives and the actual outcome, and then investigating to determine the root causes of the focus points. To clearly maintain motivation and expectations inside an organization, each

member needs to expect that a thorough debrief will be conducted with the overall goal of identifying the underlying cause of any less-than-perfect outcomes. More details on this process are explained in Appendix A.

Principle 4: The Government Team Leads the Way

- High level of expectations for government personnel (military and civilian) to run programs
- Focus on full use of government personnel capabilities – technical competence is expected

Rapid organizations work hard to find and hire military and government experts. Government personnel are expected to run the programs, often times without a prime contractor or support contractors as part of the organization. Many of the rapid programs interviewed had a small support contractor footprint, if at all--compared to most major acquisition programs. This is not to say they did not employ or rely on contractors to provide leadership or technical support on a large or small scale. However, when programs did have a support contractor workforce, the expectation was still the same: The government engineer, program manager, operations representative, etc., was expected to be the resident expert on the program.

These government teams are typically comprised of a set of functional experts as a development team. Core capabilities will exist on these teams – a program acquisition officer, resource/financial manager, system engineer, operational expert, safety, and test personnel. Technical competence is the standard, not the exception. It is expected every member of the team is technically able to run their portion of the program. They maintain awareness of activities and issues on all aspects of the development program, regardless of government or contractor responsibility. There is little room for redundancy.

In conversation with a Chief Engineer from a large program office at SMC, the following interaction was recounted: At a weekly internal program review several support contractors were briefing status with a handful of Lieutenants and Captains sitting silent around the room.

One month into the job he asked the support contractors to hold their concerns and asked the Captains to brief. They could not. His question back to them was, “Why are you here?”

PROCESS

Principle 5: Defined Set of Stable Requirements Focused on Warfighter Needs
Principle 6: Small Co-Located Teams
Principle 7: Document to Capture the Intent of DoD 5000.2
Principle 8: Designing out All Risk Takes Forever…Accept Some Risk of Failure
Principle 9: Keep an eye on Normalization

Principle 5: Defined Set of Stable Requirements Focused on Warfighter Needs

- Get the requirements right--everything you do stems from them!
- Capability based requirements rooted in customer derived "CONOPS"
- Use solid systems engineering (SE)
- Expedite trade studies – then make a decision and press forward
- Focus on providing the 23-80% solution

Defining stable requirements focused on the customer needs was one of the most frequently occurring principles during the interviews. Not only is there not enough time to do everything a customer is asking for, but customers often ask for more than they really need to meet their operational objectives. It quickly became evident through the interviews, that every one of these organizations spends a significant amount of time up-front, face-to-face with their customer discussing requirements and operational context. They may actually spend more time hashing out a solid set of requirements than they do in actual design and production.

Our interviews brought to light several frustrations of the requirements development process. Customer disconnects or unrealistic expectations may emerge because customers are unaware of the state-of-the-possible. Customers may not understand how difficult it might be to accomplish their requests. Occasionally, a customer may have observed a system used by another entity and think "I need one of those"—seeing a product versus indentifying a specific capability. In response, the rapid organizations are deeply rooted in a capability based approach to requirements analysis. This drives concepts of operations based analysis, where the customer must clearly define specific needs, uses, or capabilities for the system—in an operational context.

Equally important is an effort to keep the requirements stable. Irrespective of the scope of a project, requirements creep will negatively impact the timeline of a project, delaying the delivery of operational capabilities to the warfighter. Further, requirement changes potentially weaken the scope of the project or may negate any perceived increase in baseline capability. As a tenant for rapid SE, stabilizing requirements starts with ensuring the requirements are *right*—in other words, directly interacting with the customer to determine what the paramount needs are rather then satisfying all-inclusive wants. Organizations that consistently execute rapid SE and acquisitions are rooted in high-quality requirements. In essence, rapid acquisition requires stable requirements.

Rapid organizations validate requirements early and often with the customer to determine needs based on capabilities. The acquiring organization must be willing to push back against unfeasible requirements, or schedule impacting requirements, in the interest of time. As one senior officer explained, "[The organization must] fight hard to have the warfighter make trades" to establish requirements that are possible in the desired timeframe. Simply put, focus on valid requirements that can be met by the state of the possible in a short amount of time.

The application of solid SE principles during early requirements definition promotes unambiguous and achievable requirements. SE ideologies emphasize relating requirements to specific design criteria and ensuring the traceability of those requirements from the system-level downward. Through an interactive process with the customer, the focus should be on concept refinement, defining the system trade-space, developing system-level and derived requirements, making appropriate system-level tradeoff decisions and critically searching for problems and disconnects. Applying these concepts at the beginning of the project (and iteratively throughout) can foster achievable objectives with reduced late-in-phase design effort.

The short duration of rapid acquisition projects naturally lends to more stability in requirements. First, grand changes in technical maturity or capability are not often experienced in the lifecycle of the project. Second, there are fewer changes in political administration (funding), leadership (rotating Colonels) and program personnel; each personality bringing to the project a new perspective or priority than their predecessor. Finally, the requirements stemming directly from urgent warfighter needs are less likely to change over the short period of time.

Ironically, requirements creep can become a pitfall of regular customer involvement in requirements refinement. Several organizations emphasized the necessity to fight requirements creep once stable requirements have been established. However, stopping creep cannot be done at the expense of customer and user involvement. In this manner, an art must be developed to keep the user in the loop without allowing for spurious changes to the project once underway. A chief task for the Systems Engineer should be persistent analysis of derived requirements in conjunction with making difficult decisions regarding system requirement trades and concept refinement.

Rapid programs rarely provide the customer with 100% of what they ask for. Interviewees expressed the typical "80% solution" concept, but also a more realistic (albeit academic in number) "23% solution" in practice. By framing the question to the customer as "Instead of XX in 10 years, I can give you XY in a few," the user may be more inclined to agree. One interview with a space focused organization responded "50% or 23% done quickly can be very acceptable." Often eliminating or modifying certain requirements will provide the warfighter with a viable solution to a problem within an expedited, achievable timeline rather than a never-ending pursuit of the 100% solution.

The requirements process often boils down to the program team getting the customer to clearly articulate exactly what capabilities they need in the field. Just as critically, these conversations and research by the development team help the customer understand the performance and schedule risk of pushing the state-of-the art too far. Clearly understanding the capabilities of industry and current technology significantly improves customer expectations of what can be accomplished in a short amount of time. This then shapes the product design space. Then, after some quick analysis, the program team can say, "A 100% solution will take 4 years. However, I can get 40% of what you want in about 9 months and it will do X, Y and Z. Will that work?" The answer is often an enthusiastic "yes". In this environment, an organization can be seen as heroic for being able to provide a solution that does two or three things really well, delivered in a short amount of time; rather than providing the warfighter a system that can do those same three things and assumedly several others after five years (or more).

Principle 6: Small Co-Located Teams

- Small teams with the right skill sets to solve the problem
- Co-located workspace and facilities

As the research explored the characteristics of the people of these rapid focused organizations, a consistent organizational pattern materialized. First, these organizations were made up of small teams; with each team member bringing a diverse set of skills to the collaborative effort. Precise data on team size was not collected, but indications are toward project teams smaller than 10. This size easily facilitates collaboration, communication and enables team members to stay connected to one another's work.

Second, these teams were typically co-located to facilitate face-to-face interaction in order to expedite problem solving and work. This is not unusual in most program or engineering offices, but specifically putting the cross-functional team members within close proximity, if not

in the same work area, was a common theme. One organization interviewed felt that co-location was so important; a temporary building was acquired to co-locate their team. If co-location is not possible, such as when working with customers from an operational unit, the organizations go through great lengths to either bring the customer to the team or vice-versa. Another common method, particularly when a large government contractor was involved, is to send a government team representative to the contractor site for extended periods of time to facilitate communication and work flow on behalf of the acquiring organization.

As previously discussed, successful teams are made up of a diverse set of people, all offering a different set of experiences, education, skillsets, and perspectives. But having them on the team is not enough – they must work together and collaborate to accomplish some common goal. Co-location of small teams is proven in these organizations as an effective method in creating synergies amongst the team members, and providing a constant interactive environment for the program workflow.

Principle 7: Work to Capture the Intent of DoDI 5000.02

- Tailor the acquisition and system engineering process to the product
- Establish a clear and short approval chain
- Document what is important and decisions made – not much else
- Use various contracting vehicles to accomplish different tasks

It may appear to the casual viewer that these rapid organizations are the "Wild West" of the DoD acquisitions community. However, solid acquisition and engineering approaches to solving complex technical problems and fulfilling real operational needs were consistently observed. Because of the specialized nature of each office, many have developed in-house processes adaptable to each new program. This ensures each program office has a specific roadmap leading it to success, and each project lives within its own specific process and lifespan.

In the interest of time, these organizations ensure every acquisition or SE process they implement is *tailored to the product.* Anything not required, deemed unnecessary, or found to be non-value added is set aside. Adhering to the full intent of DoDI 5000.02, they apply it to their specific product without excess. It may appear these organizations are skipping steps in the acquisition process. The research indicates these steps are not skipped, but rather tailored to meet the stringent timelines required to deliver product to the warfighter. For example, a Systems Engineering Plan (SEP) may consist of only two pages within a higher level document, instead of a 30 page stand-alone file. They use formal and informal review processes, specifically milestone-type reviews, with the right people in attendance to make go/no-go decisions on the spot. The focus is to document important technical and programmatic information and critical decisions. *There are no documents produced for documentation sake.*

In interviewing some organizations, it became evident their approval chain for reviews and program milestone approval had been shortened. Additionally, the approval chains were clearly defined. In most of these organizations, there are very few extraneous persons in the review chain that do not have some sort of approval authority or intrinsic value added (such as legal or contracting).

The brevity of these approval chains often stems from a Program Management Directive (PMD) outlining the decision making authority within these organizations. This document can outline specific positions with approval authority, typically pushing it down to a lower level of responsibility within the organization, shortening the approval chain and reducing the time required to make programmatic decisions. Some of this brevity may also stem from the classification level of the project, literally preventing some personnel from participating.

Finally, program size may keep budgets under Major Defense Acquisition Program (MDAP) thresholds.

An often frustrating part of the acquisition process is bureaucracy. Interviewees indicated that occasionally some individuals believe they need to be part of a review process ostensibly because of their position, leadership or not, which can become a road block for the program team. Conversations reveal this behavior may be caused by personal agendas, need for a feeling of empowerment or importance, or simply because the process has always been done a certain way. In rapid programs, if someone does not have value to add, they are not included. This was not to the exclusion of participation, but value added by personnel directly or indirectly involved in the process is critically analyzed. This analysis helps avoid the pitfall of people merely adding time to the process and pushing back on the review process without bona fide authority to do so.

Another practice is to *combine*, not skip, program level reviews. For example, test plans, Technical Readiness Review Boards (TRRB), Safety Review Boards – if deemed low risk, can be signed off at the local level in a single review. This is also applied to pre-milestone decision reviews as well. This concept does not indicate system engineering processes and thoroughness are brushed aside. The approach is to shorten the approval and review process timeline by combining review processes and reducing the lull created by waiting for a review process to take place – not to diminish the quality of the product or eliminate SE analysis processes.

Another common trend is the use of various contracting vehicles to accomplish different tasks, some of which are in place for several years, for use when needed or to provide frequently used specific services. Indefinite Delivery Indefinite Quantity (IDIQ) contracts were important to several organizations to provide as-needed support on a reoccurring basis. This approach

requires a special type of contracting capability, referred to by one organization as "creative contracting". This can only be done by contracting officers who are willing to investigate the art of contracting – discover how something *could* be put on contract in a way most advantageous to the product and program situation—all within the bounds and utilizing the full flexibility of the Federal Acquisition Regulation (FAR).

Principle 8: Designing out All Risk Takes Forever…Accept Some Risk of Failure

- Creative (and implementable) solutions are allowed
- Mitigate risk through the use of mature and proven technology
- Potential for failure is accepted, because providing something may be better than nothing
- Determine the level of risk the customer is willing to accept

The organizations interviewed operate under an uncommon risk paradigm when compared to many large DoD acquisition programs. In rapid, the potential for "failure" through providing only a partial or short term solution to the field may be acceptable, as this may be preferable to delivering nothing at all. These teams are made up of technical experts who cognitively assess the risks of different technical solutions throughout the design process, sometimes with formal risk assessment processes in place. This idea of risk mitigation through use of mature and proven technology led several programs to adopt the concept of demonstrations or prototyping versus modeling as a better use of time and resources. The bottom line often came down to the level of program or technical risk the customer is willing to accept—emanating from detailed conversations with the customer. If the warfighter could utilize a partial solution and is willing to take some technical risks with a prototype in the field, delivery times are considerably shortened and feasible solutions can be arrived at allowing testing in the field and real-world feedback for incremental improvements.

According to Merriam-Webster's dictionary, "create" is defined as: To produce through imaginative skill (Merriam-Webster, 2012). While thinking creatively is not necessarily

commonplace in everyday acquisition, in rapid acquisition it is absolutely acceptable and quite often critical to success. Creative and implementable solutions must be sought in order to do things rapidly. Some of this success hinges on expert understanding of the design space, potential technical solutions, and the ability to integrate existing technologies. Rapid programs work through a rigorous design process, working to identify and eliminate risks. However, attempting to design-out all risk is a time consuming and costly process, and not realistic if attempting to get a solution out to the customer quickly.

Principle 9: Keep an Eye on "Normalization"

- Track your technical debt
- Do configuration management, even if it is in your engineer's head
- Buy or maintain data rights or a build-to spec

"Normalization" is a term heard at one of the larger DoD rapid acquisition offices, but the concept was reoccurring. It essentially describes the transition of a program from a prototype or rapid project into a major acquisition program or into some form of mass production. Most of the organizations interviewed typically work in small-rate production runs (a few to less than 15). Thus, the investments required for product implementation are minimal compared with a large aircraft program predestined for a full rate production phase and years of sustainment. However, as many rapid projects have the potential to become normalized, it is advantageous for these offices to keep their eyes on this possibility and be prepared for a transition to happen.

Technical debt, another term heard at one of the organizations, is a concept coined by Mark Cunningham in the early 1990's as a way to describe the risks and compromises made in rapid development. He first applied the concept to software development:

> "Shipping first time code is like going into debt. A little debt speeds development so long as it is paid back promptly with a rewrite... The danger occurs when the debt is not repaid. Every minute spent on not-quite-right code counts as interest on that debt. Entire engineering organizations can be brought to a stand-still under the debt load of an

> unconsolidated implementation, object-oriented or otherwise." (Cunningham, The WyCash Portfolio Management System, 1992)

Mr. Cunningham has recently commented that this concept has been misinterpreted and confused with the idea that you can do sloppy or poor work up front with the intention of doing a good job later. (Cunningham, Debt Metaphor, 2009). That is not the case with the rapid organization whose primary purpose is to provide *useful* products to the warfighters in the field. Providing a poorly executed product to the field, however rapidly, would quickly render these organizations useless.

The technical debt concept allows these organizations to move forward quickly, before they may fully understand the problem, all the while tracking what has been assumed or skipped in the design, engineering, and systems management realm. The importance of tracking these processes comes into play as the program matures; particularly if the program is successful and is normalized into a larger military procurement program or new program of record. If these processes or analyses are not tracked, it will be difficult to know what work might need to be completed as the program moves into traditional maturity. For example, on a small-scale small-shop project, configuration management may have been done in the engineer's head. However, if there is a desire to mass produce an item, configuration management and a true product baseline will be needed. Knowing what systems-level work has or has not been accomplished is critical to successful transition to a normalized and potentially mass produced product.

This concept also confirms a popular topic amongst all acquisition and engineering programs—data rights. Many of these organizations specifically mentioned the benefits of purchasing or maintaining some level of government owned data. The level of data required varies between programs, but the intent was consistent: Have enough data to provide the ability to modify when necessary, maintain competition, and easily transition toward normalization.

PRODUCT

Principle 10: Use Mature Technology – Focus on the State of the Possible
Principle 11: Incremental Development is Part of the Product Plan
Principle 12: Smaller Budgets Receive Less Oversight and are More Stable

Principle 10: Use Mature Technology – Focus on the State of the Possible

- Focus on integration of mature technologies
- Reuse existing capabilities, platforms, etc. – especially if they are flight-certified

In rapid acquisition, untested and unproven technology poses an enormous risk to system success. Unlike most traditional acquisition programs, there is no time for technology to mature, in other words, no time for schedule slips due to immature technology struggling to develop. To avoid this pitfall, most rapid programs focus engineering efforts on the interfaces required to blend multiple existing technologies into a system capable of providing the desired set of capabilities. Another aspect of rapid is modifying an existing platform or simply adding subsystems and components. Program teams stay abreast of emerging technology and leverage the work done by industry and other military programs. They then engineer a system-of-systems solution to meet requirements. This bounds their design space within the state of the possible – that has, in part, already been proven. In Technology Readiness Level (TRL) terms, this means nothing less than a TRL 6, preferably 7 or 8. This, in combination with the concepts of reuse and incremental development, allow these teams to field quickly, but generationally provide more and more capability.

In many cases, the urgent need requests are to satisfy a newly emerged operational requirement. These organizations perform an abbreviated analysis of alternatives (AoA) to determine how best to meet that need. By the time the request arrives at one of these organizations, current technical capabilities indicate a materiel solution can be developed for the warfighter. Often times, the concept of delivering a partial solution is driven not only by time,

but also by technical maturity. While a laboratory may have proven that something is feasibly possible, its use in the battlefield is several years away. However, by leveraging existing components and integrating them in a new or innovative way, these organizations are able to provide an equivalent or interim solution in short order. In this environment, the warfighter is given something to use now, and as technology matures, they can expect greater capability in the future.

Another essential characteristic of rapid product development is the reuse of existing technical capabilities. This is further improved when existing technical capabilities are integrated onto existing platforms. A great example is a recent modification one organization performed to improve a small fleet of Combat Search and Rescue (CSAR) helicopters. Rather than develop a new forward looking infrared radar (FLIR) pod or lift hoist, the team examined the operational requirements requested by the user and identified *existing* technology currently being installed by the US Army on Department of State and Federal Bureau of Investigation helicopters. This reuse approach saved the program office over half of the potential contracted price (about $3M saved) and 12 months of schedule. In addition, the customer also received a Government-owned technical data package (TDP) because the design and engineering work was done in-house.

Another significant reduction in time for this example was the time saved in flight test by using equipment that had already been flight-certified. This approach created huge efficiencies in their flight test program as many of the test requirements had already been accomplished by a previous program.

Principle 11: Incremental Development is Part of the Product Plan

- "Generational development" - plan for technology maturity, advancement, and cycles
- Look for unpredicted outcomes

Part of the agreement of accepting a partial solution may also include the plan for incremental development. When this concept is decided upon from the beginning of any development program, it enables "generational development" – an intentional plan for technology maturity, advancement, and cycles of growth. This may be done by using open architectures, modular concepts, clearly defining system interfaces, and utilizing industry standards. When planning for incremental growth in platform capabilities from the start, particular systems level planning is put into place. This approach allows known or unknown technical improvements to be more easily integrated into the baseline system—providing faster upgrading and an enhanced ability to share system level data. Overall, this approach will extend the system lifecycle and enhance its ability to flexibly meet the needs of an ever changing technical and operational environment.

Finally, as these organizations march through their development programs, many are constantly looking for unpredicted design outcomes. In one organization, during the latter stages of product development a specific set of questions were asked: Who else could use this? How else could it be used? What does this enable next? How could this be used against us? This series of questions put this team in the right mindset to further the development and utilization of their products.

Principle 12: Smaller Budgets Receive Less Oversight and are More Stable

- Budget size may become its own enemy
- Rapid funding is typically: Assured, from various sources, and may require recoloring

Budgets are often thought of as a process principle, but it depends on the context. One benefit many of the rapid program offices enjoy is a *lack* of size. When you are to move fast, smaller is often better. Not only do large organizations create challenges to effective management and full utilization of all personnel resources, they tend to have larger budgets. Big

programs and big budgets can easily become targets for increased oversight, longer approval chains, and funding cuts. In this sense, being big creates its own problems. Size becomes its own enemy.

In this research, the size of the program budgets appeared directly related to the products themselves. The design and technologies selected to meet operational requirements directly impact the cost of the program. Sub-system product selection, interface complexity, sustainment considerations, and technical maturity all drive cost. Keep in mind these organizations are focusing on the 23-80% solution, are not going into mass production, and are not necessarily planning for long-term sustainment. They are also not developing $300M fighter jets. However, these organizations intentionally take steps to reduce the overall size of their budgets. For example, the willingness to accept some types of risk *buys down* the cost of the design, development and manufacturing efforts. Costs (and risk) are also reduced by using proven or mature technology. Utilizing simple or standard interfaces can help reduce complexity—reducing development costs.

As with contracting officers, many rapid organizations have dedicated finance personnel who work to manage the cornucopia of funding sources for these projects. Imagine the variety of funding types coming into an organization that executes projects for all military branches, several 3-letter government agencies, and foreign military sales. These organizations rely on the flexibility of multiple funding types. Some customers come to them with a need, but arrive with funding from various sources or not the right color of money. It takes a special kind of organization and finance officer to understand, acquire and execute these funds.

Conclusion

Data Analysis

In conclusion, we hypothesized rapid acquisition organization success is governed by a common set of principles and that via interview sessions with these organizations, common governance would emerge. Through our analysis, a common set of principles did emerge and attempts are already being made to apply some of them to traditional acquisition programs.

Table 2. Principle/Concept Occurrence in Interviews

Principle	Title	# of Times Cited
1	Build and Maintain Trust	46
2	Populate Your Team with Specific Skills	53
3	High Levels of Motivation and Expectations	24
4	Government Team Leads the Way	12
5	Defined Set of Stable Requirements	46
6	Small Co-Located Teams	30
7	Intent of DoDI 5000.02	57
8	Designing out All Risk Takes Forever	17
9	Keep an Eye on "Normalization"	9
10	Use Mature Technology	47
11	Incremental Development	23
12	Smaller Budgets Get Less Oversight	5
	Total Citations	369

While each organization interviewed was unique in the products produced and the processes used to produce them, research saw several significant and common themes emerge from the data. Table 2 shows the number of times a specific principle was materially brought up or cited as a significant business practice in the interviews. This lends to a "top 5" list of most significant attributes of rapid organizations, comprising 67% of our data points.

Top 5 List

1. Work to Capture the Intent of DoDI 5000.02
2. Populate Your Team with Specific Skills and Experiences
3. Use Mature Technology – Focus on the State of the Possible
4. Defined Set of Stable Requirements Focused on Warfighter Needs
5. Build and Maintain Trust

Further qualitative data analysis shows co-occurrences (i.e. correlations) between several principles. Patterns emerged showing co-occurrences of principles to one another based on their appearance together in the data set. For example, analysis showed the principle "populating your team with specific skills and experiences" frequently occurring with the principle "build and maintain trust". In fact, the strongest co-occurrences appeared between four of the "Top 5" principles and "Small Co-located Teams". Of the top five, only "Use Mature Technology" did not show strong co-occurrence values with the other principles.

These results are somewhat intuitive. As can be seen in Appendix D, people principles most frequently co-occurred with other principles. This implies the principles that define the people on a team drive the overall performance of the effort. If organizations have the right people supporting a program, it appears they are more likely to keep process where needed and get the right product delivered. Significant co-occurrence with regards to product is centered on stable requirements and incremental development. Drilling down into these two principles, we conclude a better product emerges with stable and well defined requirements in an incremental development plan. Strong process principle co-occurrences' links back to utilizing people through small co-located teams. In addition, conceptually working through standard DoDI 5000.02 processes with well defined requirements created the core of most rapid programs.

Supposition

A set of stable requirements is a must for any program, but even more so in an environment where time is of the essence. Focusing on what is considered necessary to get the mission done versus what may be "wanted" is equally critical to quickly putting something in the field. Also observed were unique environmental attributes helping to optimize the program management process. Small, empowered teams centrally located in the same facility helped to

enhance cooperation, communication and productivity. These teams, formed of the right mix of highly competent personnel, made accomplishing the mission in rapid form a possibility. From a process perspective, shortened approval chains stemming from classification of the program or PMD's granted at DoD levels greatly reduced time spent acquiring go/no-go decisions. Further, tailoring approval for DoDI 5000.02 specified documentation reduces paperwork, approval processes, and redundant staffing.

From an engineering perspective, researchers observed very few "cannot fail" programs. Rather, these programs were "must succeed" for the sake of the warfighters fighting the current fight. This is enhanced by the utilization of mature technology, but also enabled by the entrepreneurial spirit of these organizations where creative thinking and strategic risk taking were allowed. Finally, while there may be some nontraditional engineering practices observed, these organizations took very seriously the brevity with which they were executing processes. Through one method or another, organizations focused on what was absolutely necessary to accomplish the design, test and build processes, all the while tracking what would have been done if more time was available.

With so many rapid offices in existence, it may seem rapid is becoming "normal". Air Force senior leaders have publically acknowledged the benefits of utilizing these methods. In recent remarks, AF Secretary Michael Donley discussed the new bomber program.

> "In contrast to the previous Next Generation Bomber program, this long-range bomber will leverage mature technologies to deliver on-schedule and in sufficient quantity before the current fleet ages out. We will constrain requirements, lower technical risk, put more emphasis on affordability, and use an established, streamlined model for program management and oversight." (Donley, 2011)

Further, the Air Force announced that its Next Generation Bomber will be managed "in a streamlined fashion" under the auspices of the Rapid Capabilities Office (Reed, 2012), one of the organizations interviewed for this research.

The processes and practices applied to meeting urgent needs must generate innovative conceptual solutions, quickly truncate the design space, and choose good designs that can deliver warfighting capability as fast as technically possible. The processes and practices applied to urgent needs programs must add value and not require an excessive bureaucratic oversight to implement, while at the same time address, understand, and manage program and technical risk. It is the overall intent of this guidebook to present these principles as an analysis of how rapid organizations conduct their business: Who is selected to work in these organizations, how they make key programmatic and system engineering decisions, and what drives the selection of technology used to meet the operational needs of warfighters. Equipped with these principles, traditional acquisition programs may have opportunities to consider another way of doing business in hopes a new approach may help solve problems experienced on programs of a larger scale.

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Appendix A: Establishing a Debrief Culture

Many concepts can be borrowed from the strong debrief culture of tactical military aviation, where the debrief is an environment in which team members can speak freely without reprisal and constructive criticism is expected by all. In flying organizations, the platitude "there's no rank in the debrief" is often used to describe the debrief environment—accentuating that everyone's equal contribution and the mission is greater than the individual and their pride. The debrief is a sacred environment oriented towards the mission itself and not the specific performance of one particular team member. The debrief culture must be established at the top-level of the organization. Leadership must outline and enforce the expectations and importance of the debrief process, compelling team members to expect a focused debrief culture. The correct culture stresses determining root causes and lessons learned to better the organization rather than personal attacks on individuals. With the right expectations, team members can then focus on improving with the assumption that *no project is ever perfect*.

An effective project debrief is enabled by a structured, expected format and mediated by a member of the project leadership, such as the Program Manger. The debrief process begins with forming of objectives at the start of the project, which will be used to develop Debrief Focus Points (DFPs) during the debrief. Objectives should be tailored to the specific project and may incorporate project requirements, cost and timeline. The debrief lead determines if a DFP is present by comparing the actual outcome of the project to the expected outcome and objectives. If the expected and actual results agree (objectives are achieved), but the results were achieved in an unplanned, unexpected, or even improper fashion (raw luck, for example, was the only reason things went well), then a DFP may still be present.

Once DFPs have been determined, the debrief lead must then work to find the cause. The causes for DFPs can be titled Contributing Factors (CFs). A CF is a potential explanation for why a DFP occurred. Each DFP may have one or more CFs. The debrief lead may begin the debrief with several obvious CFs already in place, and then during focused review of the project with all team members, develop more CFs. After the focused review of the project and determination of all CFs, the emphasis should be placed on determining fixes for each CF as applicable, and finally identifying which CFs are the Root Cause (RC) for each DFP. The end-state of the debrief is the development of Lessons Learned that incorporate the RC for each DFP in pointed, clearly-written statements to be catalogued and referenced for future projects. There may be a need to conduct intermediate debriefs at specific project phases on longer projects depending on the scope of the organization and each project.

Appendix B: Rapid Acquisition Principles

PEOPLE

Principle 1: Build and Maintain Trust

- Develop solid relationships and work to maintain them
- Empowered leadership
- Autonomy for Program Managers/Engineers
- Consistent customer input & buy-in every step of the way

Principle 2: Populate Your Team with Specific Skills and Experience

- Hand pick your team…or grow your own
- Acquire people with the right education, experience, and personality
- Build the right team for each project

Principle 3: Maintain High Levels of Motivation and Expectations

- Motivation and mindset: Collaborative, competitive, impatient, creative, technical, tangible results, independent
- Mistakes are OK, but it is not OK to repeat them
- Every member connected to the mission and vision

Principle 4: The Government Team Leads the Way

- High level of expectations for government personnel (military and civilian) to run programs
- Focus on full use of government personnel capabilities – technical competence is expected

PROCESS

Principle 5: Defined Set of Stable Requirements Focused on Warfighter Needs

- Get the requirements right--everything you do stems from them!
- Capability based requirements rooted in customer derived "CONOPS"
- Use solid systems engineering (SE)
- Expedite trade studies – then make a decision and press forward
- Focus on providing the 23-80% solution

Principle 6: Small Co-Located Teams

- Small teams with the right skill sets to solve the problem
- Co-located workspace and facilities

Principle 7: Work to Capture the Intent of DoDI 5000.02

- Tailor the acquisition and system engineering process to the product
- Establish a clear and short approval chain
- Document what is important and decisions made – not much else
- Use various contracting vehicles to accomplish different tasks

Principle 8: Designing out All Risk Takes Forever…Accept Some Risk of Failure

- Creative (and implementable) solutions are allowed
- Mitigate risk through the use of mature and proven technology
- Potential for failure is accepted, because providing something may be better than nothing
- Determine the level of risk the customer is willing to accept

Principle 9: Keep an Eye on "Normalization"

- Track your technical debt
- Do configuration management, even if it is in your engineer's head
- Buy or maintain data rights or a build-to spec

PRODUCT

Principle 10: Use Mature Technology – Focus on the State of the Possible

- Focus on integration of mature technologies
- Reuse existing capabilities, platforms, etc. – especially if they are flight-certified

Principle 11: Incremental Development is Part of the Product Plan

- "Generational development" - plan for technology maturity, advancement, and cycles
- Look for unpredicted outcomes

Principle 12: Smaller Budgets Receive Less Oversight and are More Stable

- Budget size may become its own enemy
- Rapid funding is typically: Assured, from various sources, and may require recoloring

Appendix C: RT-34 Interview Questions

1. **Process (Systems engineering methods, processes, and tools)**
    a. Do you use standard/ formal SE processes in your rapid development organizations? Which ones?
    b. Are SE processes tailored for each program or product. If so, which ones can be highly tailorable and why
    c. How are SE methods, processes and tools different based on project scale/ scope
    d. What level of risk is acceptable, how do you determine that, and how do you systemically address it at all levels
    e. What is the formality of engineering documentation
    f. How replicable / transferable are your processes from one project or product to another
    g. How do model-based systems engineering approaches support your rapid development
    h. Do you integrate a variety of models/ simulations/ prototypes early in the lifecycle, and if so, how
    i. How would you describe your ability to be innovative in concept refinement
    j. What are best practices for problem domain understanding
    k. How do you manage scope and requirements
    l. What infrastructure (tools, modeling & sim) allows continuously quickening product delivery cycles
    m. Decision Analysis Processes
        i. Who, and at what level, are most engineering decisions made
        ii. Who is empowered, how do they know it, how are they supported
        iii. To what extent are major decisions documented, formalized, communicated
        iv. How do you prepare for major decisions

2. **People (including Team Collaboration)**
    a. What types of teams do you use (e.g., domain, functional, IPT, etc)
    b. What are the primary leadership roles for an expedited project or for the best projects that run the most efficiently (program or project manager, chief engineer, chief architect, etc)
    c. How do you select/ design the team
    d. What are the primary skills you seek for the team
    e. How do you effectively incorporate/involve the end user
    f. How do you effectively and continuously incorporate the user perspective
    g. How do you manage and network people and teams that are not co-located
    h. What role does collaboration play… in management, in team building, in problem solving, in SE processes, and in geographically distributed teams
    i. How do you facilitate improved collaboration (internal, external)

j. What collaborative tools or processes do you use
k. What types of meetings do you hold, who attends, who makes decisions, and why
l. How do you manage urgent project tempos and its personnel effects (stress, work hours, burnout)
m. How do you reduce complexity of the SE process

3. Product (Architectural Design Considerations)

a. How do you translate prototypes to operational use
b. How long is the intended operational lifecycle of the product
c. How many units are you producing/fielding
d. How does your rapid development schedule drive architectural/ design choices
e. How does reuse, modification of existing systems, or using product lines drive reduced schedules
f. How does the level of complexity effect the product architecture

4. Project – How are responses dependent (scalable) on size of the project (scope, cost, timeline, risk, # people)

Appendix D: Co-Occurrence Matrix

		PEOPLE				PROCESS					PRODUCT		
		Build and Maintain Trust	Populate Team with Specific Skills	Maintain Motivation and Expectations	Government Team Leads the Way	Defined Set of Stable Requirements	Small Co-Located Teams	Intent of DoD 5000.2	Designing out All Risk Takes Forever	Keep an Eye on "Normalization"	Use Mature Technology	Incremental Development	Smaller Budgets; Less Oversight
PEOPLE	Build and Maintain Trust		6	1	2	8	4	4	0	0	0	0	0
	Populate Team with Specific Skills	6		0	1	1	10	2	0	0	0	0	0
	Maintain Motivation and Expectations	1	0		0	1	0	0	0	0	0	0	0
	Government Team Leads the Way	2	1	0		0	1	1	0	0	0	0	0
PROCESS	Defined Set of Stable Requirements	8	1	1	0		0	1	0	0	2	5	1
	Small Co-Located Teams	4	10	0	1	0		0	1	0	0	1	0
	Intent of DoD 5000.2	4	2	0	1	1	0		0	1	1	1	1
	Designing out All Risk Takes Forever	0	0	0	0	0	1	0		0	0	1	0
	Keep an Eye on "Normalization"	0	0	0	0	0	0	1	0		1	0	0
PRODUCT	Use Mature Technology	0	0	0	0	2	0	1	0	1		1	0
	Incremental Development	0	0	0	0	5	1	1	1	0	1		0
	Smaller Budgets; Less Oversight	0	0	0	0	1	0	1	0	0	0	0	

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14. ABSTRACT

The purpose of the research was to explore and develop a set of principles common to rapid acquisition and expedited engineering programs utilizing grounded theory and qualitative research methodologies. To accomplish this goal, the research team interviewed over 30 organizations from across the DoD which focus on less traditional acquisition approaches such as rapid prototyping, mature technology integration, or extensive platform engineering. A set of standardized questions grouped by taxonomy of people, product, and process was used to guide open discussions. The responses from the interview notes were analyzed for trends. A set of 12 principles were identified from repeatedly emerging concepts in the systems engineering or acquisition processes of these organizations. While rapid acquisition offices often have unique attributes and permissions, these principles may be applicable to traditional acquisition programs.

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